ECOLOGICAL FACTORS

An ecosystem is a community of living organisms interacting with each other and their non-living environment. Modern ecology focuses on the basic functional ecological unit, the ecosystem. Ecosystems are composed of organisms interacting with each other and with their environment such that energy is exchanged and system level processes, such as the cycling of elements, emerge. A.G. Tansley (1935) coined the term "ecosystem" as a biological assemblage interacting with its associated physical environment and located in a specific area. The environment includes chemical, physical and biological components. When a component surrounding an organism affects the life of an organism, it becomes a factor.

In any ecosystem, a living organism is influenced by a number of factors and forces which are known as eco-factors or ecological factors. These environmental factors which influence the behavior, growth, distribution, abundance, and ultimate survival of organisms are of two basic types: abiotic (non-living) environment which determine the interactions between the population and the biotic (living) environmental factors which include interactions between different populations and instinctive control mechanism that are internal to the population itself. (Clapham, Jr., 1973).

All these ecological factors can be divided into the following three groups:

1. Abiotic factors
2. Biotic factors
3. Anthropogenic factors

ABIOTIC FACTORS

The abiotic factors are non-living chemical and physical elements in the environment that aren't living but which are important to sustain the life of the living. Abiotic factors includes: **Climatic, Edaphic, Physiographic** etc. The sum total of all these factors constitutes the environment of an organism. Every organism has an ecological minimum and maximum for every factor and the range between two limits is known as limit or zone of tolerance. To explain the effect of different limiting factors on living organisms, number of laws and principles has been

proposed by different Scientists. The law of tolerance, usually called Shelford‟s law of tolerance presented by American Zoologist Victor Ernest Shelford in 1911. The law states that, the abundance or distribution of an organism can be controlled by certain factors (e.g., the climatic, topographic and biological requirements of animals and plants) where levels of these exceed the maximum or minimum limits of tolerance of that organism. For example- For the proper development and growth of plants, all the soil nutrients are equally important, but anything in excess might limit the uptake of the other nutrient, restricting the proper growth. German Biochemist, Justus Liebig in 1840, presented the Law of minimum; it states that the growth of an organism is dependent on the amount of food stuff which is presented to it in minimum quantity. For example- if the soil is deficient in any one nutrient, it will make the other nutrient metabolically inactive and the proper growth of the plants will get restricted. Liebig‟s Law of minimum is also incorporated with the Laws of limiting factors developed by British Physiologist F.F. Blackman (1905). This law of limiting factor states that a biological process is controlled by a number of factors and the deficiency of any of these factors will affect the process on the whole. For example Photosynthesis by plants. Blackman listed five factors involved controlling the rate of photosynthesis are amount of water, carbondioxide, chlorophyll, intensity of Solar radiation and temperature of the chloroplast. The same principle of limiting factors applies to animal functions also. The abiotic variables or factors which affect the living things are given below:

A. Climatic Factors

Climate is the long term pattern of weather in a particular region. Climate is one of the important natural factors which affect the plant life and responsible for determining the climatic conditions of a region. Its study is known as climatology. The climatic factors are grouped under these categories:

1. Light
2. Temperature
3. Water (Humidity and Precipitation)
4. Wind
5. Fire

1. Light

Light is one of the most important abiotic factors without which life cannot exist. The chief sources of natural light are sunlight, moonlight, starlight. The sun is the main source of light. Light is the part of the electromagnetic spectrum that can be seen by the human eye. Electromagnetic spectrum is the term used by scientists to describe the entire range of light that exists. The electromagnetic spectrum is generally divided into seven regions, in order of decreasing wavelength and increasing energy and frequency: radio waves, microwaves, infrared, visible light, ultraviolet, x-rays and gamma rays. Each particle of electromagnetic radiation, called a photon, has certain amount of energy. Types of radiation with short wave length have high energy photons, whereas types of radiation with long wave lengths have low energy photons. Scientists break it electromagnetic spectrum into three separate categories or division. The short wave includes cosmic rays, x-rays and ultra violet rays, which have wavelengths shorter than 0.4 to 0.7 mm. This is also known as photo synthetically active radiation (PAR).

The medium sized waves are called infrared waves (longer than 0.740 mm). Radiant energy reaching the surface of the earth on a clear day is about 10% ultraviolet, 45% visible light, and 45% infrared. It is a form of kinetic energy from the sun that travels in waves in the form of tiny particles called quanta or photons. Sunlight pass through prism disperse in series of wavelength exhibiting seven different colors- violet, indigo, blue, green, yellow, orange and red (VIBGYOR). All these colors make visible spectrum of light that affect physiological processes of plant. e.g., Photosynthesis. On the basis of wave length, there are three types of ultraviolet radiation. These are:

- UV-A radiation (320 to 400 nm)
- UV-B radiation (280 to 320 nm)
- UV- C radiation (100 to 280 nm)

Out of these three radiation types, UV-C is lethal to organisms, and UV-B, is harmful to the organisms. The intensity of light reaching the earth's surface varies with the angle of incidence, degrees of latitude and altitude, season, time of the day, amount absorbed and dispersed by the atmosphere and a number of climatic and topographical features.

Importance of light to plants

Light affect the growth and distribution of plants through its effect upon soil temperature, photosynthesis, transpiration, rate of water absorption etc. Light is essential for the formation and function of chlorophyll. Three properties of this climatic factor that affect plant growth and development are light intensity, light quality and day length or photoperiod. The intensity of light is measured in terms of foot candle is equal to 10.76 Lux and varies according to the latitude and season of the year. An increased light intensity leads to a high rate of photosynthesis and a low light intensity would mean low rate of photosynthesis. At a very high intensity of light, rate of photosynthesis would drop quickly as the light starts to damage the plant. Light quality refers to the color or wavelength reaching the plant surface. Day length or photoperiod refers to the amount of time that a plant is exposed to sunlight with respect to the night period. Light affects many physiological activities of the plants. Light influences the plants in the following ways:

(i). Photosynthesis: Sunlight acts as the ultimate source of energy for plants. Plants are autotrophic organisms, which need light for carrying out the process of photosynthesis. Photosynthesis is the process by which plant converts light energy into chemical energy (in the presence of chlorophyll) which is subsequently used for the preparation of carbohydrate from carbon dioxide and water. The various wavelengths in Sunlight are not all used equally in photosynthesis. Instead, photosynthetic organisms contain light absorbing molecules called pigments that absorb only specific wavelengths of visible light, while reflecting others. The set of wavelengths absorbed by a pigment is its absorption spectrum. The best wavelengths of visible light for photosynthesis fall within the blue range (450-500 nm), and red range (600-700 nm). Therefore, the best light sources for photosynthesis should ideally emit light in the blue and red ranges. Green (500-570 nm) light is least effective. Plants look green, it is because the chlorophyll molecules in the plant absorb blue and red light and reflect other colors, resulting in the green colour we see.

(ii). Respiration: The method by which cells get chemical energy by the consumption of oxygen and the liberating of carbon dioxide is called respiration. The process of respiration in plants involves using the sugar produced during

photosynthesis plus oxygen to produce energy for plant growth. The process of respiration is represented as follows:

$$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O + 32\ ATP\ (energy)$$

Respiration takes place in all type of living cells and generally called cellular respiration. Cellular respiration is a process that takes place inside the cells where energy is released by the breakdown of glucose molecules. Cellular respiration can occur both aerobically (using oxygen), or anaerobically (without oxygen).

Plants respire all the time, whether it is dark or light. There is no direct effect of light on the respiration. Indirect effect is very important because in the presence of light the respiratory substrates are synthesized. Light at which both photosynthesis and respiration become equal is called as light compensation point. This means that the carbon dioxide released from respiration is equivalent to that which is taken up during photosynthesis. The compensation point is reached as light intensity increases. If the light intensity is increased beyond the compensation point, the rate of photosynthesis increases proportionally until the point of light saturation is reached, beyond which the rate of photosynthesis is no longer affected by light intensity.

Effect on transpiration and opening and closing of stomata: Transpiration is the biological process by which water is lost in the form of water vapor process from aerial parts, such as stems, flowers and leaves in plants. In the absence of transpiration, excess water will get accumulated in the plant cells, and the cells will eventually burst. The stomata open during the day and close in the dark. Presence of light is directly proportional to the rate of transpiration.

Light affects opening and closing of stomata, influences the permeability of plasma membrane and has heating effect. All these in turn affect transpiration which in turn affects absorption of water.

(iii) Growth and flowering of plants: The day length, the quality and intensity (photoperiodicity) of light are the most important factors which affect growth and flowering of plants. Based on photoperiodic responses plants can be classified into three groups:

(a) Short-day plants: The short day plants in general develop flowers when the days are less than 12 hours long. Example- Saccharum officinarum (Sugarcane), Glycine max (Soybean). Day length is critical and varies from species to species.

(b) Long-day plants: The long day plants develop flower when the days are longer than 12 hours. Example - Daucus carota (Carrot), Lactuca sativa (lettuce), Spinacea oleracea (Spinach).

(c) Day neutral plants: Day neutral plants are those whose flowering are not affected by day length, but rather is controlled by age, number of nodes, previous cold treatment etc. for e.g., tomatoes (Lycopersicon lycopersicum) are "day neutral" and do not flower based on the length of the day or night. Instead, tomato plants simply flower after they have reached a certain developmental age. Other examples are- Helianthus annuus (Sunflower), Cucumis sativus (Cucumber), Gossypium hirsutum (Cotton).

Plants which grow in bright Sunlight are called heliophytes and those growing in the shades are called Sciophytes. There are some heliophytes which can grow in shade are known as facultative sciophytes and those heliophytes which fail to grow in shade said to be obligate sciophytes. Similarly facultative heliophytes are those sciophytes which may grow in light and obligate heliophytes are those sciophytes which fail to grow in bright Sunlight. The shade plants maintain a high rate of photosynthesis in low light intensities, while the heliophytes are adversely affected by shade.

Movement: Sunlight affects the movement in plants. The effect of Sunlight on the plant movement is called heliotropism or phototropism. The movement of plant parts towards the light source is known as positive phototropism. For example, the growth of plant stem in the upward direction in response to sunlight, whereas the movement of plant parts away from light is known as negative phototropism. For example, roots are negatively phototropic as they grow downwards into the soil.

Germination: Most plants need light to grow and keep them healthy, but not all plants need light to germinate. Some seeds germinate best in absolute darkness, and others perform well with continuous sunlight. Experts from Thompson and Morgan report that light in the red wavelength range promotes germination, while blue light impedes it. This is because the red light affects a plant pigment, phytochrome,

(regulate the germination of seeds (photoblasty), synthesis of chlorophyll, elongation of seedlings, size, shape and number and movement of leaves and the timing of flowering in adult plants) that is within the seeds. But if the plants are below a thick canopy of leaves, blue light may be needed as well. However, in Typha species yellow light has been found to promote germination of seeds and also counters the inhibitory effect of blue light.

2. Temperature

Temperature is one of the most important ecological factors. The moisture and temperature, acting together, determine in large measure the climate of a region and the distribution of plant and animal life (Smith, 1977). Development and rate of plant growth is dependent upon the temperature surrounding the plant and each species has a specific temperature range represented by a maximum, minimum and optimum. In organisms all metabolic processes necessary for life start at a certain minimum temperature. The temperature at which physiological processes are at their maximum efficiency is called optimum temperature. Minimum temperature is that below which all metabolic processes necessary for life cannot initiate and proceed with lowest motion. The maximum temperature is the temperature above which no biological activity can be observed. The minimum, optimum and maximum temperatures are called cardinal temperature varies from species to species, and in the same individual from part to part. For example, some hot-spring algae can live in water as warm as 73°C under favorable conditions and some arctic algae can complete their life cycles in places where the temperature barely rise 0oC. Non-pathogenic bacteria inhabiting hot springs can actively grow at temperatures greater than 90oC (Bott and Brock, 1969).

Organisms which can tolerate a very large fluctuation in temperature for growths are called eurythermal plants include jasmine, roses, conifers, etc. The organisms who can tolerate only a small variation in temperature are known as Stenothermal organisms. Stenothermal plants include Eucalyptus, etc. On the basis of temperature tolerance, fungi have also been classified into the following three kinds: thermotolerant, thermophilic and mesophilic fungi (R. Emerson, 1968). Thermophilic fungi require optimum temperature 45°C for growth. Temperature influences most plant processes, including transpiration, respiration, etc

(a). Temperature and cell: The minimum and maximum temperatures have lethal effects on the cells and their components. In the extremely low temperature, cell proteins may be frozen to ice. On the other hand; heat coagulates proteins (Lewis and Taylor, 1967). Few organisms survive temperatures above 45°C because of protein denaturation at high temperature. Certain organisms can exist at higher temperature due to heat stable proteins where as some organisms can exist at slightly lower temperatures using antifreezes such as glycerol, salts.

(b). Temperature and metabolism: Usually the various metabolic activities of plants, animals and microbes are regulated by different kinds of enzymes and enzymes in turn are influenced by temperature, consequently increase in temperature, up to a certain limit, brings about increased enzymatic activity, resulting in an increased rate of metabolism. However, the metabolic rate may decrease when there is higher increase in temperature.

(c). Temperature and reproduction: Flowering in plants is affected by temperature through thermoperiodism (the sum of the responses especially of a plant appropriately fluctuating temperatures). Temperature is an important factor, in the phenology of plants. Phenlogy is the study of periodical phenomena of plants, as the time of flowering in relation to climate; colour changing and leaf fall in the autumn, etc.

(d). Temperature and Parasitic infection: Certain diseases develop on plants due to unfavorable temperature i.e., high temperature together with wind and high humidity causes dissemination and development of bacterial diseases.

(e). Temperature and growth: Plant growth and development is dependent on the temperature around the plant. Each species has a specific temperature range. Both very high and very low temperatures can have a negative effect on plant growth. There are two main forms of extreme temperature stress on plants - cold and heat. During high temperature, membrane stability decreases due to excessive fluidity of lipids in the membrane. There is a disruption of the membrane and cell compartment, leading to problems with function. Low temperatures can cause cold injuries such as dehydration, chilling injury, and freezing injury. In desiccation, tissues are dehydrated and injured due to rapid transpiration and slow absorption during winter. Chilling injury can occur at a range of temperatures that are low but

not freezing for that species. Chilling has negative effects on cellular function, growth, and colouration. It can also lead to tissue death. Freezing injury occurs when the temperature is below the freezing point of water, resulting in protoplast shrinkage, destruction of chlorophyll, and ice formation in intercellular spaces, resulting in cellular water movement toward ice.

(f). Temperature and transpiration in plants: Transpiration is the process of loss of water from the aerial surface of plants. Higher temperature increases the capacity of air to hold more moisture in vapour form, which results in difference between vapour pressure defects, hence the rate of transpiration increases. Besides increasing the rate of transpiration if temperature rises above maximum limits, the plant becomes inactive.

(g). Classification of organisms according to temperature tolerance: On the basis of the response of plants to temperature of environment, the entire vegetation can be divided into four classes as:

(a). Megatherms: Plants which require more or less constant high temperature throughout the year. e.g., tropical rain forests and desert vegetation.

(b). Mesotherms: Plants of habitat which is neither very cold nor very hot. These plants cannot endura extreme high or low temperature. e.g., tropical deciduous forests and aquatic plants.

(c). Microtherms: These plants require low temperature for their growth. These plants cannot endure high temperature. All high altitude plants of the tropical and subtropical regions included in this group.

(d). Hekistotherms: Plants growing in regions with very low temperature. They tolerate long and extremely cold winter months. e.g., alpine vegetation.

3. Water

Water is the basis of life for all living beings on the earth. Water makes up a large proportion of the bodies of animals and plants e.g., cytoplasm holds 70-80 percent of water. Water is a compound composed of two atoms of hydrogen and one atom of oxygen. It is the most abundant compound found in all organisms. Water constantly moves around the earth and changes between solid (snow, sleet, hail and ice), liquid (rain, water droplets) and gas (water vapour). The water cycle, also

known as the hydrological cycle is manage by Sun's energy. This solar energy drives the cycle by evaporating water from the lakes, rivers, oceans and even the soil. Other water moves from plants to the atmosphere through the process of transpiration. The water vapour forms clouds in the air by condensation and precipitates back to earth in the form of rain and snow. In plant, absorption of nutrients, the rate and magnitude of photosynthesis, respiration, growth and other metabolic processes are influenced by the amount of water available. Water plays diverse roles in plants. As it evaporates from the leaf tissue during transpiration, gives cooling to the leaves. It is also a chief component in photosynthesis and respiration. Water act as a solvent for carbohydrates and minerals moving through the plants. In the atmosphere, water is present in the form of water vapours. This is called atmospheric humidity. Humidity is greatly influenced by intensity of solar radiation, wind, water, status of soil, temperature, altitude etc. Evaporation of water from earth surface and transpiration from plants are the main cause of atmospheric humidity. Most of the plants cannot make use of atmospheric humidity, however, several mosses, lichens, filmy ferns and epiphytic orchids can absorb moisture directly from the air. Clouds and fog are the visible forms of humidity. Humidity is measured using a psychrometer and hygrometer and is measured as a percentage. Humidity is described in three different terms:

(a). Relative humidity: Relative humidity is the ratio of the actual amount of water vapours in the atmosphere to the amount that can be held in the air at a particular temperature and pressure.

(b). Specific humidity: It refers to the "amount of water vapours present per unit weight of air".

(c). Absolute humidity: It refers to the "amount of water vapours present per unit volume of air".

Effects of humidity on organisms: It influences the rate of transpiration in plants. Higher the humidity, lesser is the rate of transpiration. Low relative humidity increases water loss through transpiration and affects plant growth. It also influences the rate of sweat in humans. So, at high humidity sweating is more. It is an important source of water for epiphytes like lichens, mosses. It plays an important role in the germination of spores of fungi.

Precipitation: Precipitation is the release of water from clouds that falls to the ground as rain, snow, sleet, or hail. Precipitation occurs when a portion of the atmospheric becomes saturated with water vapor (reaching 100% relative humidity), so that the water condenses and 'precipitates' or falls. Precipitation depends upon temperature, wind, season and pressure. Precipitation has a significant impact on productivity and species richness of community or perennials and in determines the vegetation of particular region. Precipitation can affect germination, seedling growth and survival, and phenology (the study of recurrent phenomena), thereby altering annual productivity and species richness in many arid and semi-arid ecosystems.

Plant productivity is influenced not only by quantity of precipitation, but also by temporal patterns of precipitation at a given site. The seasonal precipitation has a stronger influence on productivity than total precipitation in arid and semiarid ecosystems, since water is the most limiting resource. The main types of precipitation include rain, snow, hail, plus a few less common occurrences such as ice pellets, diamond dust and freezing rain. Thus, mist and fog are not precipitation but suspensions, because the water vapour does not condense sufficiently to precipitate. Rainfall is the most common form of precipitation.

Moderate and continuous rains are beneficial instead of heavy rains because in the heavy rains a large amount of water is lost from the surface of soil as runoff and the soil is eroded. The distinction between equatorial forests zones, desert zones near the tropics and temperate forest zones is based upon rainfall. In India the tropical evergreen forest is found with 100 inch rainfall tropical moist deciduous forest are monsoon forest of Western Ghats, Chota Nagpur correspond to a rainfall of 60 to 68 inches, the tropical dry deciduous forest of Sal and Teak occur in regions with only 40-50 inch rainfall. The regions of negligible rainfall consist of deserts. In terrestrial habitats precipitation is the only source of water for growth of most plants.

4. Wind

Air is the invisible mixture of gases present in the troposphere. Air in motion is called wind. Wind is the movement of air, caused the uneven heating of the earth by the Sun and the earth's own rotation. Wind traveling at different speeds, different altitudes, and over water or land can cause different types of patterns and storms. They are a giant, spiraling tropical storm. Hurricane- originated over warm oceans and derives energy from the latent heat of evaporation of water sucked into low

pressure centre. These tropical storms are known as hurricanes in the Atlantic Ocean, typhoons in the western Pacific Ocean and cyclones in the western Pacific Ocean. Wind is the great equalizer of the atmosphere, transporting heat, pollutants, moisture, and dust great distances around the globe. Landforms, processes, and impact of wind is called Aeolian landforms. Wind is both an ecological provider and disturbance facilitator influences trees and other organisms. The impact of wind on plants largely depends on speed duration, and the extent to which wind can penetrate canopy layers. When the wind is strong, it can carry sand and snow particles, and thus has a considerable abrasive effect on the ground as well as on plants. The effects of wind on plant life and plant environment may be listed as follows:

Physiological impact

(i). Wind affects rate of transpiration. More transpiration occurs in strong wind regions which results water deficiency in their tissues.

(ii). Wind increases the turbulence in atmosphere, thus increasing the supply of carbon dioxide to the plants resulting in greater photosynthesis rates. Beyond a certain wind speed the rate of photosynthesis becomes constant.

(iii). Wind changes the balance of hormones and also increases the ethylene production in barley and rice.

(iv). Dwarfing: Turgidity helps maturing cells of a plant to normal sizes. The plants developing under the influences of drying winds never attain turgidity that enables them to expand their maturing cells. As a result, all organs are dwarfed because their cells attain subnormal size.

(v). When wind is hot, desiccation of the plants takes place, because humid air in the intercellular places is replaced by dry air. For example, rice crop during june-july months shows tip drying.

(vi). The wind accelerates transpiration. Plants are able to grow successfully only so long as they can balance their water income with water outgo. When transpiration rate exceeds that of water absorption, partial or complete closure of the stomata may ensure which will restrict the circulation of carbon dioxide into the leaves. As a result, there will be decrease in the rate of photosynthesis, growth and yield.

Mechanical impact of wind

(i). In high winds, leaves can be deprived from plants, and under extreme conditions, plant stems may be broken or plants uprooted. Usually such breakage occurs in soft woods of such plants as cotton woods.

(ii). Lodging: Lodging is a form of wind injury caused by violent wind in which the crop plants (wheat, maize, and sugarcane) flatted against the ground. But if the stems are not too mature, the prostrated plants become partially erect once more by means of differential growth at the lower node.

(iii). Plants growing at higher altitude show undeveloped growth because of the effects of wind.

(iv). Deformation: When developing shoots are subjected to strong wind pressure from a constant direction, the form and position of the shoot may become permanently altered. This is called deformation. Trees with inclined trunks are commonly observed on ridged. Some trees such as oaks grow flattened against the ground while in others the tree branches developing in a leeward direction.

Other Effects of Wind

(i). When the wind moves the soil from one area to another, this is called wind erosion. It is a natural process that moves soil from one location to another by wind. It can cause important economic and environment damage.

(ii). Wind causes the lifting and transport of lighter particles from a dry soil, leaving behind a surface of coarse grained sand and rocks.

(iii). Wind is a critical means of transportation for seeds, insects and birds, which can travel on wind currents for thousands of miles. The most of gymnosperms are pollinated by the wind and this phenomenon is called as anemophily. Anemophily is the process when pollen is transported by air currents from one individual plant to another.

(iv). The coastal area affected by strong wind brings salt and make the soil unsuitable for growing plants.

(v). Wind also disperses many types of particles (plant propagules, pollen, disease organisms) as well as moving gas molecules (CO_2, Pollutants).

5. Fire

Fire is that stage of heat in which things get burned and from them heat and light rays emerges which affect the environment. A fire needs three things: heat, fuel and oxygen. The fire may be caused by

(i) volcanic activity, **(ii)** lighting, and **(iii)** biological origin.

The fire is usually human caused such as campfires, arson, discarding lit cigarettes, not burning debris properly, playing with matches or fireworks and sometimes chiefly in forests develop due to mutual friction between trees (bamboos etc) surfaces. Fire affecting the plants may be of the following types:

(i). Ground Fire: This type of fire is flameless and subterranean and usually occurs in deep accumulations of humus, peat and similar dead vegetation that become dry enough to burn. These fire are particularly dangerous as they can 'hibernate' below the surface during a warm winter and reemerge one the weather gets warm again.
(ii). Surface Fire: The fire which sweep over the ground surface, their flames consume the litter, living herbs, shrubs and also scorching the trees which in contact. Surface fires are the most fame fire can be put out relatively easily.

(iii). Crown fires: The fire which extends from dense, woody vegetation and travels from the canopy of one plant to another. Crown fires pose the highest risk by far due to their fast spreading behavior.

The direct effect of fire on plants is lethal. The different plant organs like leaf, stem etc, have direct effect of fire. Due to higher temperature protoplasm gets destroyed and that plant organs dies. Fire as a destructive force can rapidly consume large amount of biomass and cause negative impacts such as air pollution, post-fire soil erosion and water runoff. Once trees have been removed by fire or logging, infiltration rates become high and erosion low to the degree the forest floor remains intact. Severe fires can lead to significant further erosion if followed by heavy rainfall.

Fire influences both living and physical elements of environment. Fire can become hazardous to surrounding infrastructure and people. It can destroy vegetation, reducing the amount of precipitation absorbed by plants. Major fires can

burn off humus in the soil and reduce soil fertility. Indirectly the fire has the following effects on vegetation:

- Fire controls the age of the forest by interrupting and altering succession. Periodic fire limits the number of saplings that survive and hence the number of trees per hectare.

- Fire helps in removal of competition of surviving species.

- Fire impacts on habitats, stimulating flowering and fruiting of species and increasing the availability seeds and berries. The quality and quantity of browse increase after fire and the population of wood boring insects increase. This is important to quail and wood peckers.

- Reduce competition, allowing existing trees to grow larger. To control the encroachment or development of undesirable food plants such as legumes for both forage and soil improvements or shrubs.

- It stimulates seed production or opening of cones and prepares seedbeds for seeding, either naturally or artificially. Some plants like Populus tremuloides get stimulated to growth by fire.

- Some plants, such as the Eucalyptus, lodge pole pine, Banksia have serotinous cones or fruits that are completely sealed with resin. These fruits or cones can only open to release their seeds after the heat of a fire has physically melted the resin.

- Fire remove unpalatable growth remaining from previous seasons and stimulate growth during seasons when there is little green grazing. Several grasses such as Cynodon dactylon, Aristida stride etc get stimulated by fire to produce large quantities of seeds.

- Fires often remove alien plants that compete with native species for nutrients and space, and remove undergrowth, which allows sunlight to reach the forest floor, thereby supporting the growth of native species.

- Fire removes low-growing underbrush, cleans the forest floor of debris, opens it up to sunlight, and nourishes the soil. Reducing this competition for nutrients, allows established trees to grow stronger and healthier.